CLAIMS

What is claimed is:

1. A plasma enhanced chemical vapor deposition process comprising:

admitting a hydrocarbon gas into a deposition chamber;

admitting titanium tetrachloride gas into the deposition chamber;

forming a plasma in the deposition chamber having at a power level greater than a first ionization energy, but less than a second ionization energy, of the hydrocarbon gas for forming hydrocarbon radicals therein; and

heating a substrate to a temperature for some of the radicals formed from the hydrocarbon gas to react with some of the chlorine atoms from the titanium tetrachloride gas for depositing titanium metal on a portion of a surface of the substrate.

2. The process of claim 1, wherein the substrate is heated to a temperature within a range of about 200°C to about 500° C.

3. The process of claim 1, wherein the hydrocarbon gas is selected from a group of compounds comprising C_nH_{2n+2}, C_nH_{2n} and C_nH_{2n-2}.

4. The process of claim 1, wherein the hydrocarbon gas comprises an alkane having fewer than five carbon atoms per molecule.

5. The process of claim 4, wherein the hydrocarbon gas includes methane.

6. The process of claim 1, further comprising:

mounting the substrate on a susceptor;

heating the susceptor; and

heating the substrate using the susceptor.

7. The process of claim 1, wherein the titanium tetrachloride gas includes a titanium tetrachloride gas mixed with a carrier gas selected from a group consisting of helium, argon and hydrogen.

8. The process of claim 7, wherein the titanium tetrachloride gas includes titanium tetrachloride gas introduced into said carrier gas using a bubbler apparatus.

9. The process of claim 7, wherein a liquid injector sprays the titanium tetrachloride and passes through a vaporizer.

10. The process of claim 1, wherein the hydrocarbon gas includes a hydrocarbon gas mixed with a carrier gas selected from a group consisting of helium and argon.

11. The process of claim 1, further comprising:

removing reaction products from the deposition chamber during the process.

12. The process of claim 11, wherein an alkyl chloride gas comprises a reaction product.

13. The process of claim 1, wherein the deposition chamber comprises a cold wall deposition chamber, the walls thereof maintained at a temperature within a preferred range of about 100°C to about 200° C. for preventing condensation of titanium tetrachloride thereon.

14. The process of claim 1, wherein the deposition chamber comprises a hot wall deposition chamber.

15. The process of claim 1, wherein the plasma comprises a plasma produced with a radio frequency source.

16. The process of claim 15, wherein the radio frequency source comprises a radio frequency source having a power setting within a range of about 20 watts to about 100 watts.

17. The process of claim 15, wherein the radio frequency source comprises a radio frequency source having a frequency greater than about 10KHz.

18. The process of claim 1, wherein the deposition chamber comprises a deposition chamber for maintaining a pressure within a range of about 2 torr to about 100 torr.

19. The process of claim 1, wherein the deposition chamber comprises a deposition chamber for maintaining a pressure within a preferred range of about 2 torr to about 5 torr.

20. The process of claim 1, further comprising:

premixing the titanium tetrachloride gas and the hydrocarbon gas before being admitted to the deposition chamber.

21. The process of claim 20, wherein a ratio of the hydrocarbon gas to the titanium tetrachloride gas comprising the premixture thereof comprises a ratio of between about four and about one thousand to one.

22. The process of claim 1, wherein the substrate comprises a semiconductor wafer.

23. A plasma enhanced chemical vapor deposition process comprising:

admitting hydrocarbon gas into a deposition chamber;

admitting titanium tetrachloride gas into the deposition chamber;

forming a plasma within the deposition chamber of the hydrocarbon gas for forming hydrocarbon radicals;

maintaining the plasma at a power level greater than a first ionization energy, but less than a second ionization energy, of the hydrocarbon gas for forming the hydrocarbon radicals; and

heating a semiconductor wafer to a temperature sufficient to induce some of the hydrocarbon radicals to react with some chlorine atoms from the titanium tetrachloride gas for forming chlorinated hydrocarbon molecules for depositing titanium metal on a portion of a surface of the semiconductor wafer.

24. The process of claim 23, further comprising:

maintaining the deposition chamber at a pressure within a range of about 2 torr to about 10 torr.

25. The process of claim 23, wherein the power level comprises a radio frequency source operating at a power setting within a range of about 20 watts to about 100 watts and at a frequency greater than about 10 KHz.

26. The process of claim 23, further comprising:

premixing the titanium tetrachloride gas and the hydrocarbon gas for their admission to the deposition chamber in a ratio of hydrocarbon gas to the titanium tetrachloride gas being between about four and about one thousand to one.

27. The process of claim 23, wherein the hydrocarbon gas includes methane.

28. The process of claim 23, wherein the hydrocarbon gas includes a hydrocarbon gas selected from a group consisting of compounds C_nH_{2n+2}, C_nH_{2n} and C_nH_{2n-2}.